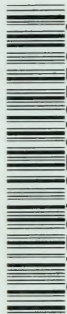
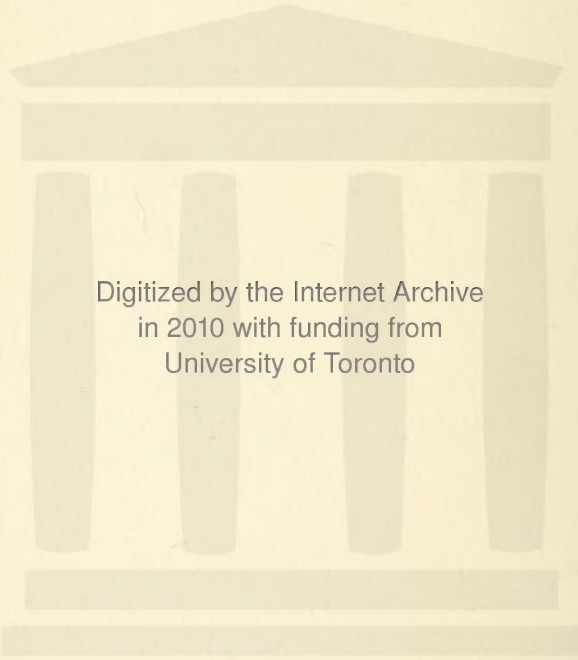


SCHOOL EFFICIENCY MONOGRAPHS

AN EXPERIMENT
IN THE
FUNDAMENTALS
MEAD



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**AN EXPERIMENT IN THE
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SCHOOL EFFICIENCY MONOGRAPHS

AN EXPERIMENT IN THE FUNDAMENTALS

GIVING THE RESULTS OF TESTS MADE
IN THE CINCINNATI SCHOOLS WITH
TWO KINDS OF PRACTICE MATERIAL

BY


CYRUS D. MEAD

ASSISTANT PROFESSOR OF ELEMENTARY EDUCATION
COLLEGE FOR TEACHERS, UNIVERSITY OF CINCINNATI



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LETTER OF TRANSMITTAL, WITH A SUMMARY OF THE RESULTS OF THE EXPERIMENT

November 23, 1916

MR. RANDALL J. CONDON,
Superintendent of Schools,
Cincinnati, Ohio.

My dear Mr. Condon:

The following is a condensed and abbreviated form of an accompanying complete report on our tests of Arithmetic practice pad material:

Material. Courtis' *Standard Practice Tests* in the four fundamentals: World Book Company.

Thompson's *Minimum Essentials* in the four fundamentals: Ginn and Company.

Time. Fifteen minutes daily, February to May inclusive, 1916.

Pupils employed. About 900 fifth-graders, divided into two approximately equal groups, of 24 classes from 14 Cincinnati schools.

Method. Preliminary and final standard tests with each group (Series B).

Four months' intervening work by the controlled method, with respective material for each group.

Median accomplishments as measures of comparison.

Purpose. To obtain an estimate of the relative values of the two kinds of practice material.

Data. Scores for each pupil in the preliminary and final tests, and daily scores.

Opinions and criticisms of teachers and principals.

Results. Given in the following tables and charts.

TABLE XVIII

A COMPARISON OF CLASSES FOR MEDIAN RESULTS IN ADDITION
ACCURACY

School	1	2	3	4	5	6	7	8	9	10	11	12	Total	Average
--------	---	---	---	---	---	---	---	---	---	----	----	----	-------	---------

Courtis Material

Test I	68.8	80	87.1	60	67.7	61	63.3	84.4	66	62	61.2	72.5		
Test II	61.6	80	68	72	87	60	86	96.6	78	80	83	80		
Gain	-7.2	0	-19.1	12	19.3	-1	22.7	12.2	12	18	21.8	7.5	98.2	8.2

Thompson Material

Test I	66	72	83.7	81	59	66	70	75	66.2	81	61	66		
Test II	64	70	71.6	83.3	81.4	66	60	83	70	78	68	77		
Gain	-2	-2	-12.1	2.3	22.4	0	-10	8	3.8	-3	7	11	25.4	2.1

Using the median growth as a measure of comparison, eight classes using the Courtis material increased in per cent of accuracy in addition, three decreased, and one made no change, as compared with six, five, and one, respectively, using the Thompson material. The sum total and average (of the median gains) show in the last columns above (Table XVIII). With classes compared, these are approximately the results also in subtraction and multiplication. In division, the number of classes making median gains or losses was equal. The following table shows these data, together with the gross algebraic gain in efficiency; i.e., the per cent of pupils attempting or exceeding a certain number of examples with one hundred per cent accuracy.

TABLE XIX

	Courtis Material Classes				Thompson Material Classes			
	Gained	No change	Lost	Gross effi- ciency gain	Gained	No change	Lost	Gross effi- ciency gain
Addition	8	1	3	81.8	6	1	5	41.2
Subtraction	10		2	151.1	9		3	31.4
Multiplication	8	1	3	121.7	9		3	84.3
Division	9		3	212.8	9		3	144.4

Number of classes, however, making gains or losses is a poor measure of comparison, because the amounts of gain or loss have no weight. A more just and exact method would be a grouping of all pupils in either of the two materials. Inequalities and variations would tend to be smoothed out in the larger massing, and medians would more nearly approximate the true conditions. The frequency tables (Tables XX to XXII)¹ show the total number making a score in attempts or in per cent accuracy regardless of class, and herein lie the most valid comparisons. Charts I to V on the following pages picture these results.

¹ See pages 43, 44, and 45.

Chart I

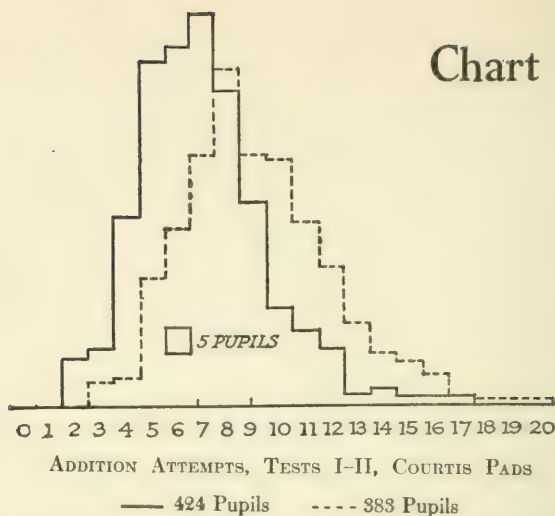
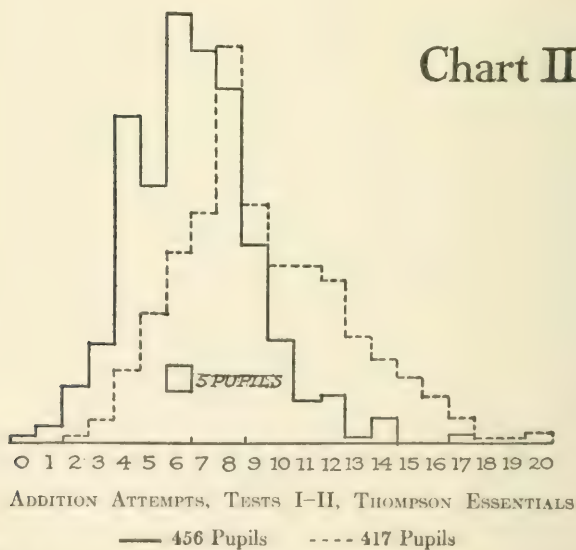
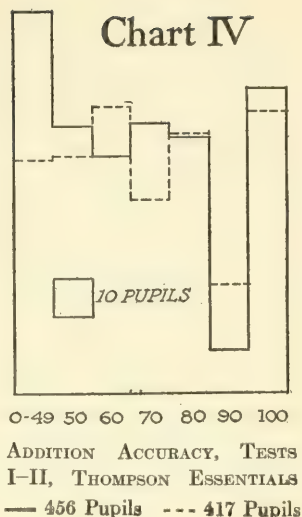
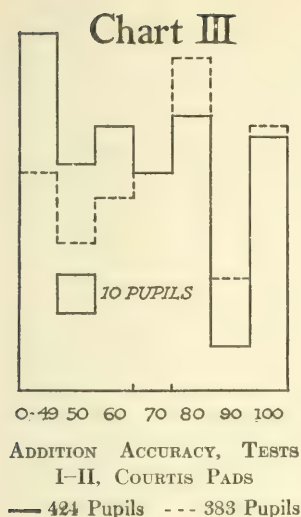


Chart II





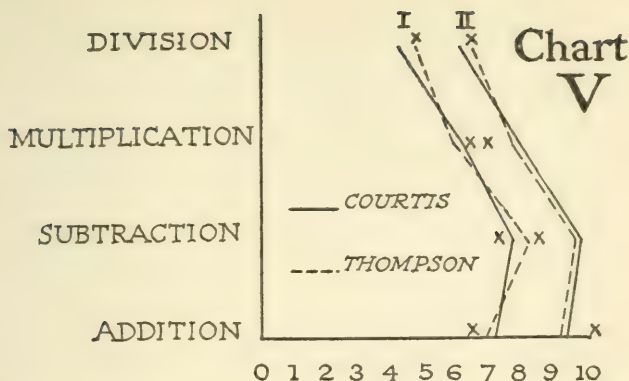
Charts I and II picture the results shown for addition attempts in Tables XX and XXI. These results are typical also of subtraction, multiplication, and division attempts. Regardless of material used, when it came to initial and final speed or attempts, one group made approximately as much advance as the other, as shown in the dotted-line surfaces. Charts III and IV picture the results for addition accuracy, as given in Table XXII. Taking seventy per cent as a central measure for accuracy, the dotted surface to the right in Chart III shows the per cent accuracy gain for each measure, — eighty, ninety, and one hundred. The seventy per cent accuracy group remained stationary; the groups below this fell off, or took their places in the increased accuracy groups. In Chart IV the seventy per cent group was less in the final results; the eighty and ninety per cent groups had gained, as had also the sixty per cent group, while the

one hundred per cent group had fallen off. (The per cent of children leaving the classes, and hence not measured in the final test, was approximately the same for both groups, or 9.6 in one and 8.6 in the other.) These results are apparently typical of subtraction and multiplication. In division, however, the Thompson material ranked favorably with the Courtis. Chart V gives the complete data (medians) for all the fundamentals in attempts and accuracy.

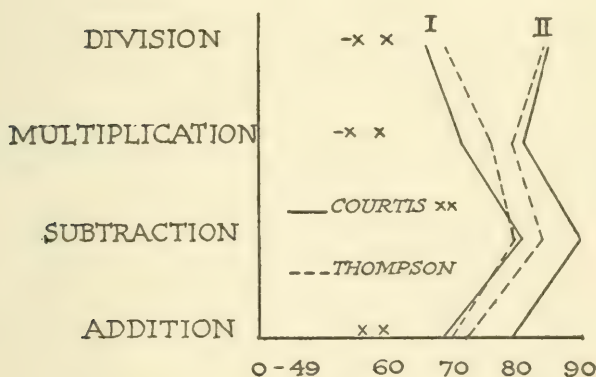
It is interesting to call attention to the results in one class which had no practice material and which pursued "the regular work." This shows for each process by the letter "X." This class was less accurate in June in multiplication and division than it was in February. Their attempts approximated the medians for the two large groups, but their accuracy was below at all times.

The opinions and criticisms of the various teachers and principals are appended at the close of the complete report. As a rule, each teacher seemed to like the material she used, some, however, expressing preference for the Courtis. In some schools only one kind of material was employed; hence there was no basis for comparative opinions. The principals who gave opinions tended to favor the Courtis pads. From the net comparative results, the Courtis pads were of more benefit in increasing pupils' accuracy in the fundamentals. The time element was probably added to by the zealously of the teacher to do the test work accurately. Under properly controlled conditions, the actual time should not exceed ten minutes daily; in fact, it were best if it did not do so. In some classes more proficient pupils aided the teacher in the outside checking and clerical work. When the proper system is found, there should be no complaint as to time.

I wish to thank you for so generously supplying us with this material for testing purposes, and also to express to



MEDIAN NUMBER OF EXAMPLES ATTEMPTED BY ALL PUPILS IN THE
PRELIMINARY AND FINAL TESTS. X IS ONE CLASS
HAVING NO PRACTICE MATERIAL



MEDIAN PER CENT ACCURACY BY ALL PUPILS IN THE PRELIMI-
NARY AND FINAL TESTS. X IS ONE CLASS HAVING
NO PRACTICE MATERIAL
(- X MEANS LOST BY SECOND TEST)

you my sincerest appreciation of the professional work and interest of principals and teachers, without whose sympathetic coöperation we can make no progress.

Respectfully submitted,

CYRUS D. MEAD

Assistant Professor of Elementary Education

**AN EXPERIMENT IN THE
FUNDAMENTALS**

AN EXPERIMENT IN THE FUNDAMENTALS

DURING the school year of 1914-1915, Superintendent Randall J. Condon of the Cincinnati Schools asked the opinion of the Department of Elementary Education of the College for Teachers, University of Cincinnati, as to the comparative values of two kinds of practice material in the fundamentals. This material had been called to his attention by representatives of publishing houses. Without experimental data, one judgment would have been as valid as another. At the request of the Department, the Superintendent supplied it with enough of the two kinds of practice material to test one thousand pupils over a series of months by the controlled method.¹

SELECTION OF SCHOOLS AND TEACHERS

It was decided to limit the tests to fifth-grade pupils. Various principals were asked to recommend one or two fifth-grade teachers of their schools who would enter willingly into the work and upon whose care and judgment reliance could be placed. The number of volunteers far exceeded the twenty-four classes desired, and from among them schools were selected which had for the

¹ Attached to the report as submitted to Superintendent Condon were samples of the two kinds of practice material used (Courtis' *Standard Practice Tests* and Thompson's *Minimum Essentials*), together with a form of Courtis' *Standard Research Tests: Arithmetic, Series B*, the standard test that was given as a preliminary and a final test to all pupils of both groups.

most part two separate fifth grades, in order that each school might try out both kinds of practice material. Furthermore, the selection of schools was so made that the differing conditions of the city were represented. In fact, the interest and professional spirit on the part of the principals was so marked that it was a little embarrassing to make a selection of schools. The following is a list of schools chosen for the experiment, with names of principals and teachers:

SCHOOLS	PRINCIPALS	TEACHERS
Madisonville	C. M. Merry	Etta O'Hara Mabel C. Rybolt
Sherman	W. S. Strickland	Jessie G. Fischer
Raschig	William Kaefer	Clara Roth
Bloom	T. W. Gosling	Stella M. Hummel Anna D. Pugh Katherine H. Riley
Fairview	G. B. Bolenbaugh	Dora Kruckemeyer
Highlands	J. M. Davis	Katherine Nunn
Evanston	U. D. Clephane	Mary Sullivan
Garfield	J. H. Locke	Elizabeth Braunecker Amy G. See
West Oakley	H. L. Crane	Georgeina Brandstettner Edith Fridman
Stowe	Jennie D. Porter	Laura Knight Anna Sandford
Westwood	J. O. Beck	Aline Morgan May Warnking
Sixth District	J. S. Hauer	Mollie Brisbin Alma Getz
Douglass	F. M. Russell	Elizabeth Brown H. A. Parham
Avondale	L. P. Stewart (Acting)	Margery Houser Edna Spillard

INSTRUCTIONS TO PRINCIPALS AND TEACHERS

It was of course of the greatest importance that the controlled conditions be kept as nearly equal as possible.

Copies of the following letters of instructions were accordingly sent to each principal:

January 17, 1916

Mr. J. S. HAUER,
Principal Sixth District School,
Cincinnati, Ohio.

My dear Mr. Hauer:

You have kindly offered to help us evaluate the Thompson *Minimum Essentials* and the Courtis *Practice Tests* material. With Mr. Condon's sanction, we wish to try out this material in twenty-four fifth grades. You have recommended Miss Brisbin and Miss Getz. I am glad to have their help; they will be aiding in a very valuable piece of experimental work. In order to carry on this work, which will be a part of the regular classroom instruction for the rest of the year, it will be necessary for all the group to get together three or four times between now and June. The preliminary work will be taken up next Tuesday at four o'clock, in Room 15 at the University. I am asking that you please notify the teachers above who have volunteered their services. I am anxious for a full meeting this time. You yourself will be welcome. In case Tuesday at four is impossible, Wednesday at four will do.

Thanking you, I am

Most cordially yours,

CYRUS D. MEAD
Assistant Professor of Elementary Education

January 25, 1916

Miss JENNIE D. PORTER,
Principal Stowe School,
Cincinnati, Ohio.

My dear Miss Porter:

Will you please notify Laura T. Knight and Anna Sanford of the following:

All teachers of both groups will give the Courtis Standard Research Test, Series B, to the pupils of their fifth grade on Thursday and Friday, January 27 and 28. Give Tests One and

Two on Thursday, and Tests Three and Four on Friday. In case one of these days is not practical, Monday, January 31, will do to complete this preliminary test. Be very careful of the time limit with each test. Have all pupils use pencils that are in good condition. You will find an answer blank inclosed. Follow all directions closely and complete the work up to and including point sixteen of the instructions.

Sample material for the practice work has been sent to each teacher of the two groups. They should familiarize themselves with this material. On Monday afternoon at 4 P.M. there will be a meeting in Room 15 at the University for all members. Samples of median scores and graphs will be made. The practice material will be issued so that regular daily work in this might begin on Tuesday, February 1. I am in hopes there will be no further need for meeting before June.

Very truly yours,

CYRUS D. MEAD

Assistant Professor of Elementary Education

MR. J. S. HAUER,
Principal Sixth District School,
Cincinnati, Ohio.

My dear Mr. Hauer:

Will you please hand this to Miss Brisbin and Miss Getz:

Directions for Using the Arithmetic Practice Material

In order that approximate uniformity may result in the giving of the two kinds of practice material in the twenty-four fifth grades selected, the teachers are requested to follow, as closely as their regular class programs will allow, these broad directions:

1. Employ about fifteen minutes, of your 50 to 60 minutes' daily arithmetic time, in the practice work. This should include the passing of material, the test or practice work, supplementary drill, scoring, graphing, and collecting material. Devote the remaining time which is scheduled for arithmetic to the processes called for in the fifth grade, and to as much concrete or applied arithmetic as is possible. See the newer texts.

2. Those pupils below the median should be encouraged to use some otherwise spare time in addition to the above or a little "outside study," if necessary, in order that they may raise their scores.
3. Practice daily. Lead the pupils to regard the work with pleasure, and as self-competition. Be careful, however, that a temptation to cheat is not realized.
4. Remember that this is a test of the relative merits of two kinds of material and not a test of any school, class, or teacher.

I wish to compliment the principals and teachers on the professional spirit in which they have undertaken the experiment. If our efforts prove of value, we wish to be able to motivate, concentrate, and make more purposeful throughout the grades the formal phases of arithmetic in order that more time may be expended on real arithmetic. This has been the idea since its conception a year ago, but this idea has been so clearly stated by Professor Stone (Stone's *Arithmetical Abilities*, the dissertation that gave Curtis much of his inspiration) in the January, 1916, *Atlantic Educational Journal*, that he is quoted. He says: "Like every other good thing, Standard Tests have their dangers. Perhaps the most serious one is that of overemphasis; for example, these practice tests measure progress in the formal work only; and unless care is taken to counteract it, this fact is very liable to cause teachers to think that the formal work is most essential. The safe view to take of tests of formal work is that their great value lies mainly in the help they give in getting the formal operations conquered and out of the way promptly, that the main time and energy may be placed upon the more important phases of arithmetic, namely, the thinking or reasoning phases."

Yours truly,

CYRUS D. MEAD

Assistant Professor of Elementary Education

Mr. J. S. HAUER,
Principal Sixth District School,
Cincinnati, Ohio.

May 23, 1916

My dear Mr. Hauer:

Will you please read and hand the following to Miss Brisbin and Miss Getz:

Directions for Giving the Final Series B Tests

All teachers of both groups will give the Courtis Standard Research Test, Series B (the second one), to the pupils of their fifth grades on Thursday and Friday, June 8 and 9. Give Tests One and Two on Thursday, and Tests Three and Four on Friday. In case one of these days is not practical, choose the two nearest days. Be very careful of the time limit with each test. In fact, all the conditions should be as nearly identical as possible with those of the preliminary tests given January 27 and 28. Use for scoring and tabulating only those pupils who took part in the original test.

See that a clean erasure has been made of all answers on the forms used in the preliminary tests; also be sure that the scores for each test under "No. Attempted" and "No. Right" have been erased. The same pupil can use the form he originally used, with the new date added. Let the first date still show, however. The June scores should be entered on the front and back page under "Second Trial." Read again carefully the instructions for scoring and tabulating. Folder D, Series B, and the sample sheet showing the "Use of Record and Graph Sheets" will aid you again. New Class Record Sheets are inclosed for the June distribution of scores in attempts and rights. See that these are made out in duplicate, as those of the first series of tests should also be. Return both sets of Class Record Sheets; also the front and back sheets of Series B showing individual scores of both dates, and all teacher's material pertaining to Series B. (This does not include the tests themselves or any of the practice pad material. Use these as you see fit.)

A form is inclosed on which criticisms and suggestions from the principals and teachers are desired. Thanking you, I am

Very truly yours,

CYRUS D. MEAD

Assistant Professor of Elementary Education

PRACTICE PAD EXPERIMENT ¹

Name of teacher

School

Date

Kind of material used.

How much of your time daily was required?

Did the class profit?

Was the interest sustained throughout?

Do you think such material valuable enough to supply all grades?

What is your general opinion and criticism?

.....

.....

Principal's opinion of the relative merits of the two kinds of practice material.

.....

.....

METHOD OF GIVING THE TESTS

In order to measure the progress made by two groups, an identical test must be given to each group both preliminary to and after the different practice materials are used. The median gain (or loss) should give an approximate estimate of the changes made by each of the two kinds of practice material used intermediately. The initial ability of the twenty-four classes in the fundamentals was obtained accordingly by applying the Courtis Standard Research Test, Series B, on January 28, 1916. By a purely chance selection, one fifth grade of a school was given one kind of practice pad material, while the other fifth grade was given the second kind of material. This made twelve classes of something like 450 pupils in each group. The time to be devoted to this formal phase

¹ The form referred to in the last paragraph of preceding letter.

of arithmetic was approximately equal with both groups of classes. The regular arithmetic work was to be pursued for the remainder of the time devoted to this subject for the day. The pupils were encouraged, however, to make any use they saw fit of the practice sheets outside of class. The slower ones in particular were urged to do this. This is a perfectly legitimate use of the practice material and is supposedly one of its merits. On June 5 or 6 the final test was given with the same Series B Standard Research Test. The results obtained with this test give us our measures of comparison.

SAMPLES OF CLASS RECORD SHEETS

The forms shown on the inserts opposite are samples of Class Record Sheets, on which are given the scores in addition and subtraction of one fifth grade for the preliminary and final tests of Standard Research Tests, Series B, or present standards in the fundamentals. The work of the teacher, verified, also appears.

COMPARATIVE STANDING OF CINCINNATI PUPILS

Just where the Cincinnati fifth-grade pupils stood, before any practice work was begun, as compared with the fifth grades of other cities, and pupils in general, had not occurred as of any special interest until the Superintendent raised the question. Comparative scores in attempts and rights were to be found in the Courtis Bulletin Number 3, February tabulations, 1914, and the 1914 Supervisory Graph. Using the median scores of Bulletin 3 as standards for comparison, the table on page 9 presents the relative standing of Cincinnati, Boston, and Detroit fifth-grade pupils, as well as fifth-grade pupils in general, and the probable June standards.



COURTIS STANDARD RESEARCH TESTS

Class Record Sheet

RECORD SHEET
No. 1
Series B

DUPLICATE

City Cincinnati School 8 Herman

Teacher Joseph S. Fischer Date: 1st Trial

Grade 5 Room 2
2nd Trial June 6, 1916
Total Scores

SUMMARY OF CLASS SCORES

Test No. 1 ADDITION	Median	Speed or Accuracy Attempts or Rights	Efficiency	Test No. 2 SUBTRACTION	Median	Speed or Accuracy Attempts or Rights	Efficiency	Test No. 3 MULTIPLICATION	Median	Speed or Accuracy Attempts or Rights	Efficiency	Test No. 4 DIVISION	Median	Speed or Accuracy Attempts or Rights	Efficiency	L. N. F.
1st Trial																
2nd Trial																
Change																

Test No. 1. Addition. Standard Scores: Grade 3, 3; Gd 4, 5; Gd 5, 7; Gd 6, 9; Gd 7, 11; Gd 8, 12. Accuracy 100%

Score		Score in number of Examples Attempted																										Total	%
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
%	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
100							2		2	2																	16	17	
90											2	1															13	8	
80											1																6	6	
70												1															5	16	
60												2	1														6		
50																													
0 to 49	0	0	0	0-1	0-1	0-2	0-2	0-3	0-3	0-4	0-4	0-5	0-5	0-6	0-6	0-7	0-7	0-8	0-8	0-9	0-9	0-10	0-10	0-11	0-11		3		
Total							4	5	6	7	6	3															31		

Median Scores: Speed 9.1 Accuracy 80.0 Efficiency $\frac{4}{31}$ or 13% Standard Scores 7-7

m. D. = 1.2 m. D. = 16.6

Test No. 2. Subtraction. Standard Scores: Grade 3, 4; Gd 4, 6; Gd 5, 8; Gd 6, 10; Gd 7, 11; Gd 8, 12. Accuracy 100%

Score		Score in number of Examples Attempted																								Total	%		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
%	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
100									2	1	3	1			2												19	10	
90	Accuracy Figures in small type indicate scores in number of examples right.		—	—	—	—	—	—	—	—	5	2	2	2														11	11
80			—	—	—	4	5	6	7	8	8	9	10	11	12	13	13-13	13-14	14-15	15-16	16-17	16-17	17-18	18-19	19-20	20-21		1	
70			—	—	3	—	—	5	6	7	7	8	9	10	10-11	11	12	12-13	13-14	14-15	14-15	15-16	16-17	17-18	17-18	17-19		5	
60			—	2	—	3	4	—	5	6	6	7	8	8-9	8-9	9-10	10-11	11	11-12	12-13	12-13	13-14	14-15	14-15	15-16		1		
50			1	—	2	—	3	4	4	5	5	6	6-7	7	7	8	8-9	9-10	9-10	10-11	10-11	11-12	11-12	12-13	12-13	12-14		2	
0 to 49	0	0	0	0-1	0-1	0-2	0-2	0-3	0-3	0-4	0-4	0-5	0-5	0-6	0-6	0-7	0-7	0-8	0-8	0-9	0-9	0-10	0-10	0-11	0-11		2		
Total									4	2	11	4	3	2	4	1											31		

Median Scores: Speed 10.9 Accuracy 94.6 Efficiency 31 or 29% Standard Scores 8-8

m. D. = 1.3 m. D. = 10.0



ORIGINAL
COURTIS STANDARD RESEARCH TESTS

RECORD SHEET
No. 1
Series B

City CincinnatiSchool De Herman

Grade 5 Room 2

Total Score

Teacher Deane J. Fischer

Date: 1st Trial Jan. 27 - 1916 2nd Trial

SUMMARY OF CLASS SCORES

	Change	2nd Trial	1st Trial
100	98	97	96
90	88	87	86
80	78	77	76
70	68	67	66
60	58	57	56
50	48	47	46
40	38	37	36
30	28	27	26
20	18	17	16
10	8	7	6
0	-2	-3	-4

Test No. 1 ADDITION			Test No. 2 SUBTRACTION			Test No. 3 MULTIPLICATION			Test No. 4 DIVISION		
Median			Median			Median			Median		
Speed or Attempts	Accuracy or Rights	Efficiency	Speed or Attempts	Accuracy or Rights	Efficiency	Speed or Attempts	Accuracy or Rights	Efficiency	Speed or Attempts	Accuracy or Rights	Efficiency
8.4	80	8%	8.9	85.7	18%	6.8	84.6	8%	4.7	90	15%
9.1	80	13%	10.9	94.6	29%	9.0	85.5	29%	6.7	100	32%
.7	0	5%	2.0	8.9	11%	2.2	.9	21%	2.0	10	17%

Test No. 1. Addition. Standard Scores: Grade 3, 3; Gd 4, 5; Gd 5, 7; Gd 6, 9; Gd 7, 11; Gd 8, 12. Accuracy 100%

Score		Score in number of Examples Attempted																								Total	%	
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23			24
%	100	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	6	13
Accuracy	90	Figures in small type indicate scores in number of examples right.	—	—	—	—	—	—	—	—	—	9	10	11	12	13	14	15	16	17	18	18-19	19-20	20-21	21-22	22-23	3	8
	80		—	—	—	4	5	—	7	8	8	9	10	11	12	12-13	13-14	14-15	15-16	16-17	16-17	17-18	18-19	19-20	20-21	10	10	
	70		—	—	3	—	—	5	6	7	7	8	9	10	10-11	11	12	12-13	13-14	14-15	14-15	15-16	16-17	17-18	17-18	5 ²⁰		
	60		—	2	—	3	4	—	5	6	7	8	8-9	8-9	9-10	10-11	11	11-12	12-13	12-13	13-14	14-15	14-15	15-16	15-16	7		
	50		1	—	2	—	3	4	—	4	4	5	5	6	6-7	7	7	8	8-9	9-10	9-10	10-11	10-11	11-12	11-12	12-13	2	
0 to 49	0	0	0	0-1	0-1	0-2	0-2	0-3	0-3	0-4	0-4	0-5	0-5	0-6	0-6	0-7	0-7	0-8	0-8	0-9	0-9	0-10	0-10	0-11	0-11	6		
Total						4	9	3 ¹⁶	9	7 ¹⁰	5 ¹⁴	1	1													39		
Median Scores: Speed <u>8.4</u> Accuracy <u>80.0</u> Efficiency <u>$\frac{3}{9}$ or 8%</u> Standard Scores <u>7-7</u>																												

Test No. 2. Subtraction. Standard Scores: Grade 3, 4; Gd 4, 6; Gd 5, 8; Gd 6, 10; Gd 7, 11; Gd 8, 12. Accuracy 100%

Score		Score in number of Examples Attempted																								Total	%		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
%		—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	10		
100						1		2	1	3	2	1																	
90	Accuracy ✓ Figures in small type indicate scores in number of examples right.			—	—	—	—	—	—	—	—	9	10	11	12	13	14	15	16	17	18	18-19	19-20	20-21	21-22	22-23	13	9	
80		—	—	—	4	5	6	7	8	8	9	10					12-13	13-14	14-15	15-16	16-17	16-17	17-18	18-19	19-20	20-21	14	14	
70		—	—	3	—	—	5	6	7	7	8	9	10			10-11	11	12	12-13	13-14	14-15	14-15	15-16	16-17	17-18	17-18	6	12	
60		—	2	—	3	4	—	3	5	6	6	7	8			8-9	8-9	9-10	10-11	11	11-12	12-13	12-13	13-14	14-15	14-16	15-16	5	
50		1	—	2	—	3	4	4	4	5	5	6	6-7	7	7	8	8-9	9-10	9-10	10-11	10-11	10-11	10-11	11-12	11-13	12-13	12-14		
0 to 49		0	0	0	0-1	0-1	0-2	0-2	0-3	0-3	0-4	0-4	0-5	0-5	0-6	0-6	0-7	0-7	0-8	0-8	0-9	0-9	0-10	0-10	0-11	0-11	1		
Total						3	4	4	10	7	5	4	2														39		

Median Scores: Speed 8.9 Accuracy 85.7 Efficiency 7 or 18% Standard Scores 8-8

m. d. = 1.4m. d. = 12.0

39

ATTEMPTS				TEST 1 — ADDITION				RIGHTS				
Grade	Detroit	Boston	Gen- eral	Prob- able June Stand- ards	Cincinnati		Detroit	Boston	Gen- eral	Prob- able June Stand- ards	Cincinnati	
					Courtis	Thomp- son					Courtis	Thomp- son
5	6.7	7.2	7.1	7.5	7.2	7.0	3.9	3.7	3.9	4.0	4.96	4.88
6	8.4	8.3	8.0	9.0	..	..	4.6	4.9	4.4	5.0	..	..
5	..	..	..	..	*9.3	9.2	..	..	..	..	*7.3	6.65

TEST 2 — SUBTRACTION

5	8.0	7.6	6.5	8.0	7.8	8.1	5.5	4.9	4.5	5.5	6.3	6.4
6	8.8	9.0	8.9	10.0	..	..	6.2	6.3	6.1	7.0	..	..
5	..	..	..	..	*9.7	9.7	..	..	..	..	*8.6	8.1

TEST 3 — MULTIPLICATION

5	6.4	5.8	6.0	7.0	6.1	6.0	3.8	3.3	2.6	4.0	4.4	4.5
6	7.4	6.9	7.2	8.5	..	..	4.8	4.8	4.5	5.5	..	..
5	..	..	..	..	*7.9	7.8	..	..	..	..	*6.4	6.1

TEST 4 — DIVISION

5	4.9	4.5	4.5	5.0	4.3	4.9	2.7	2.0	2.3	3.0	2.8	3.3
6	6.4	5.8	5.8	6.5	..	..	4.4	3.3	4.3	5.0	..	..
5	..	..	..	..	*6.2	6.5	..	..	..	..	*5.2	5.45

* On June 1—after practice.

Several points are noticeable in the above table of results. The division of the classes into the two practice groups was by chance. The teacher whose name began with a letter nearest C was assigned the Courtis material, the other one of the pair, the Thompson material. The groups divided approximately equal, the Thompson group in division, however, being one-half example better in the beginning. The Cincinnati pupils in February worked, perhaps, a little more slowly than other pupils by the (probable) June standards, but in accuracy of work they exceeded in February the standing of Detroit and Boston pupils, and pupils in general, for the June following. It is probable that all teachers should strive for one hundred per cent accuracy. Only about five per cent of both children and adults, however, attain such a standard. Both the Courtis and Thompson practice sheets, after the fifteen minutes' daily use, advanced their groups of pupils well beyond the probable June standards for sixth-grade classes.

TABLES SHOWING THE RESULTS OF THE TESTS¹

Tables I to XVI, which follow, present the accomplishments in attempts and accuracy of each class, with its proper practice material, in both the initial and final tests in the four fundamental processes. The medians, deviations, and efficiency for each group of pupils appear at the bottom of the tables. In Tables XVII to XIX the results are assembled so that classes and schools may be compared. It should be noted, however, that such comparison was not the purpose of the experiment.

¹ In calculating central tendencies and deviations, short-cut approximate methods were used. See Folder D, Series B, Computations, Courtis' *Standard Tests*. The author wishes to acknowledge aid in checkings and computations given by Charles H. Skidmore of Utah and David F. Carpenter of New Hampshire.

TABLE I
ADDITION ATTEMPTS — COURTIS' PRACTICE TESTS

TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	...
1	..	..	..	..	..	..	..	..	..	..	..	..	...
2	2	..	..	1	1	1	..	1	..	..	3	..	9
3	2	..	..	2	..	1	3	..	..	..	3	..	11
4	4	..	1	4	..	6	7	1	2	2	8	2	37
5	7	4	9	10	6	11	6	2	1	5	3	3	67
6	6	9	2	2	7	8	11	6	3	4	10	1	69
7	6	3	8	4	6	7	11	5	4	11	4	7	76
8	8	9	6	4	7	3	4	2	7	6	2	4	62
9	4	7	3	..	2	2	..	6	4	5	2	4	39
10	1	5	..	..	1	1	..	5	..	4	..	1	18
11	..	1	2	..	..	1	..	2	4	1	..	3	14
12	..	1	1	..	..	..	..	1	4	1	1	2	11
13	..	..	1	..	..	..	..	..	..	..	..	1	2
14	..	..	..	..	..	..	..	..	2	..	1	..	3
15	..	..	..	..	..	..	..	..	1	..	1	..	2
16	..	..	..	..	..	..	..	..	..	1	..	1	2
17	..	..	1	..	..	..	..	..	1	..	..	..	2
18	..	..	..	..	..	..	..	..	..	..	..	..	...
19	..	..	..	..	..	..	..	..	..	..	..	..	...
20	..	..	..	..	..	..	..	..	..	..	..	..	...
	40	39	34	27	30	41	42	31	33	40	38	29	424
Med.	6.8	8.4	7.6	5.7	7.1	6.2	6.4	8.5	9.0	7.9	6.2	8.5	
M.D.	1.6	1.5	1.6	1.1	1.1	1.2	1.1	1.8	2.2	1.4	1.7	1.5	

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	1	..	..	1	1	..	1	..	..	..	4
4	1	..	..	..	..	2	..	1	..	..	1	..	5
5	4	..	3	1	3	4	5	..	..	1	2	1	24
6	3	4	3	5	2	5	5	..	..	..	4	3	34
7	3	5	6	6	6	6	4	1	1	..	4	6	48
8	15	6	5	4	2	4	8	4	3	3	5	6	65
9	5	7	3	7	3	3	1	3	2	4	4	6	48
10	5	6	1	2	3	4	5	4	4	10	1	2	47
11	2	3	2	1	..	1	2	6	8	7	2	2	36
12	..	..	3	..	4	2	4	1	4	6	1	2	27
13	..	..	..	..	1	..	1	6	2	4	1	1	16
14	..	..	..	..	..	..	1	2	4	..	1	2	10
15	..	..	1	..	2	..	1	..	..	3	1	..	8
16	..	..	1	..	..	..	..	..	1	..	3	1	6
17	..	..	1	..	..	..	1	..	..	..	..	..	2
18	..	..	..	..	..	..	..	..	..	1	..	..	1
19	..	..	1	..	..	..	..	..	..	..	..	..	1
20	..	..	..	..	..	..	..	..	1	..	..	..	1
	38	31	31	26	26	32	39	28	31	39	30	32	383
Med.	8.6	9.1	8.6	8.2	9.0	7.7	8.6	11.1	11.6	11.3	8.8	9.0	
M.D.	1.0	1.2	2.0	1.2	2.3	1.7	2.2	1.8	1.5	1.3	1.9	1.7	

TABLE II
ADDITION ATTEMPTS — THOMPSON'S ESSENTIALS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	1	..	..	..	1
1	..	..	2	..	..	..	..	..	..	..	1	..	3
2	..	1	5	..	..	..	..	3	..	..	2	..	11
3	1	2	4	2	1	1	1	2	1	..	4	..	19
4	3	4	9	2	7	6	4	12	2	7	6	1	63
5	2	2	8	2	3	3	5	8	7	4	2	3	49
6	11	3	5	3	9	13	9	6	4	10	7	3	83
7	11	6	1	11	7	5	10	4	4	6	2	9	76
8	8	8	1	8	3	3	9	2	6	9	3	8	68
9	5	4	..	4	3	2	2	3	2	3	..	10	38
10	4	1	..	3	4	1	1	..	..	2	1	3	20
11	..	1	..	3	1	..	..	..	1	..	..	2	8
12	1	..	..	..	..	2	1	..	2	2	..	1	9
13	..	..	..	1	..	..	..	..	..	..	..	..	1
14	..	..	..	1	..	..	..	..	2	..	..	2	5
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	1	..	..	..	..	..	..	1	..	..	..	..	2
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	47	32	35	40	38	36	42	41	32	43	28	42	456
Med.	7.6	7.7	4.7	8.0	6.9	6.6	7.2	5.4	7.3	7.2	5.5	8.6	
M.D.	1.2	1.4	1.2	1.2	1.5	1.1	1.1	1.2	1.7	1.3	1.4	1.2	

TEST II

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	..	..	..
2	1	..	..	..	..	..	..	..	..	..	..	..	1
3	2	..	..	..	..	..	..	1	..	..	1	..	4
4	1	1	..	..	..	..	1	5	1	3	2	..	14
5	7	1	2	..	2	1	1	7	..	2	2	..	25
6	6	..	1	..	4	1	6	6	1	4	5	3	37
7	9	..	3	1	3	4	5	5	5	3	5	1	44
8	8	2	5	4	6	11	12	7	7	5	5	5	77
9	5	5	4	2	4	5	6	3	1	3	1	7	46
10	2	1	5	3	6	1	3	1	3	3	1	5	34
11	1	4	2	6	1	4	4	2	2	..	1	7	34
12	1	3	4	7	2	4	2	1	1	3	..	4	32
13	..	4	3	5	1	3	1	1	..	1	1	1	21
14	1	3	..	1	4	1	..	1	..	2	..	4	17
15	..	2	..	4	..	1	1	..	2	1	..	2	13
16	2	..	1	1	2	..	..	..	1	1	..	1	9
17	..	2	..	2	..	..	..	1	..	..	..	..	5
18	..	..	..	..	..	..	..	..	1	..	..	..	1
19	..	..	1	..	..	..	..	..	..	..	..	..	1
20	..	..	1	1	..	..	..	..	..	..	..	..	2
	46	28	32	37	35	36	42	41	25	31	24	40	417
Med.	7.6	12.0	10.2	12.4	9.8	9.2	8.6	7.4	8.8	8.8	7.4	10.8	
M.D.	1.5	2.2	2.0	1.5	2.0	1.6	1.4	1.8	1.5	2.2	1.2	1.6	

TABLE III
ADDITION ACCURACY — COURTIS PRACTICE TESTS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	5	6	14	4	5	1	4	6	4	4	7	6	66
90	..	3	1	..	..	1	..	4	1	1	1	..	12
80	4	10	7	5	6	5	11	9	3	5	1	5	71
70	10	5	4	4	2	6	2	4	6	6	3	4	56
60	9	7	3	..	9	8	6	5	5	5	8	3	68
50	3	2	4	3	3	5	8	3	7	11	7	2	58
0-49	9	6	1	11	5	15	11	..	7	8	11	9	93
	40	39	34	27	30	41	42	31	33	40	38	29	424
Med.	68.8	80	87.1	60	67.7	61	63.3	84.4	66	62	61.2	72.5	
M.D.	13.4	16.6	18	19	16	16	17.3	14	14	14	15.8	25	
Eff.	2.5	8	23.5	4	13.3	0	4.8	9.7	3	5	3	13.8	

TEST II

100	2	6	2	2	11	2	12	12	1	4	9	5	68
90	1	3	..	1	..	3	3	6	6	4	1	1	29
80	5	6	6	6	7	6	10	5	7	11	7	10	86
70	6	5	6	5	1	4	3	2	6	9	6	3	56
60	6	6	5	1	2	1	3	3	3	9	5	6	50
50	3	3	5	4	3	6	4	..	5	..	2	3	38
0-49	15	2	7	7	2	10	4	..	3	2	..	4	56
	38	31	31	26	26	32	39	28	31	39	30	32	383
Med.	61.6	80	68	72	87	60	86	96.6	78	80	83	80	
M.D.	17	16.6	15	17	19	18	17.5	10	15	12	15.7	17	
Eff.	5.2	13	6.4	3.8	30	3	25.6	39.2	3	10	20	12.5	

TABLE IV
ADDITION ACCURACY — THOMPSON'S ESSENTIALS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	5	5	12	10	..	1	7	15	4	11	5	3	78
90	1	1	..	1	1	..	..	..	1	2	..	5	12
80	6	3	8	10	3	10	6	4	1	9	2	5	67
70	10	9	3	7	6	6	8	2	7	4	2	6	70
60	3	4	5	5	9	3	3	3	8	8	6	5	62
50	7	7	5	2	11	8	8	6	3	3	6	3	69
0-49	15	3	2	5	8	8	10	11	8	6	7	15	98
	47	32	35	40	38	36	42	41	32	43	28	42	456
Med.	66	72	83.7	81	59	66	70	75	66.2	81	61	66	
M.D.	17	15	21	16.4	10	15.5	20	27.3	13	18.2	15	18.5	
Eff.	6	12.5	0	22.5	0	0	9.5	12	6	9.3	7	7	

TEST II

100	6	5	3	4	11	3	2	18	1	5	7	8	73
90	..	2	1	8	..	4	4	..	1	2	1	5	28
80	7	4	7	9	7	5	5	3	7	7	3	4	68
70	6	3	6	2	5	3	4	4	3	5	..	10	51
60	7	8	7	9	3	7	6	6	4	3	5	9	74
50	8	3	4	3	4	6	8	7	5	7	3	4	62
0-49	12	3	4	2	5	8	13	3	4	2	5	..	61
	46	28	32	37	35	36	42	41	25	31	24	40	417
Med.	64	70	71.6	83.3	81.4	66	60	83	70	78	68	77	
M.D.	16	14	12	14	19.3	16.5	15.6	21	14	16	20	12	
Eff.	6	14.3	3.1	10	25.7	8	0	12	4	16	16	17.5	

TABLE V
SUBTRACTION ATTEMPTS — COURTIS PRACTICE TESTS
TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	1	..	..	..	..	..	1
1	..	..	..	..	..	..	..	..	..	..	1	..	1
2	..	..	..	..	..	..	..	1	..	..	6	..	7
3	..	..	..	1	3	..	..	1	..	..	2	..	7
4	1	..	1	..	4	1	3	..	1	1	12	2	26
5	2	3	2	6	9	6	11	2	3	2	8	5	59
6	4	4	2	8	7	9	11	2	3	3	3	8	64
7	8	4	5	4	3	11	8	4	2	6	2	6	63
8	7	10	9	5	3	8	5	3	9	9	5	4	77
9	3	7	4	1	..	4	1	5	3	9	..	3	40
10	4	5	4	1	1	1	1	7	7	6	..	1	38
11	2	4	3	1	1	..	..	4	4	1	..	..	20
12	5	2	2	..	..	..	1	2	..	1	..	..	13
13	3	..	..	..	..	..	..	..	..	1	..	..	4
14	..	..	1	..	..	..	..	..	..	..	..	..	1
15	..	..	1	..	..	..	..	..	..	..	..	..	1
16	1	..	..	..	..	..	..	..	1	1	..	..	3
17	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..
	40	39	34	27	31	40	42	31	33	40	39	29	425

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	1	..	1
3	..	..	..	..	1	..	..	..	..	..	..	..	1
4	..	..	..	..	1	3	..	..	..	..	1	..	5
5	2	..	1	3	..	..	..	1	..	1	2	2	12
6	6	..	6	4	6	7	4	1	2	1	2	4	43
7	3	..	5	8	1	4	1	1	2	..	2	9	36
8	10	4	7	3	1	7	7	1	2	5	6	3	56
9	4	2	4	5	2	7	11	3	3	2	4	3	50
10	3	11	5	2	6	2	5	2	4	2	4	4	50
11	3	4	1	..	1	..	3	2	6	8	1	3	32
12	3	3	1	..	2	..	4	3	1	7	4	1	29
13	..	2	1	..	3	2	3	3	1	7	2	1	25
14	2	4	..	1	1	..	..	2	4	1	1	2	18
15	..	1	..	..	..	..	..	4	..	1	..	..	6
16	..	..	..	..	..	..	..	..	5	..	..	..	5
17	1	..	..	..	..	..	..	..	..	1	..	..	2
18	..	..	..	..	1	..	..	1	1	..	..	..	3
19	..	..	..	..	..	..	..	1	..	2	..	..	3
20	..	..	..	..	..	..	1	1	..	1	..	..	3
	37	31	31	26	26	32	39	26	31	39	30	32	380

TABLE VI
SUBTRACTION ATTEMPTS — THOMPSON'S ESSENTIALS
TEST I

Score Attempts	Sch ol 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	1	..	..	..	..	..	..	..	..	..	2	..	3
2	3	..	..	..	..	..	..	1	..	1	1	..	6
3	..	..	..	..	..	..	1	1	..	1	3	1	7
4	3	1	1	2	3	2	1	8	..	1	4	1	27
5	3	1	..	7	5	3	4	4	1	3	6	3	40
6	7	3	4	4	5	6	4	5	2	10	5	4	59
7	7	5	5	11	9	4	5	7	6	9	2	8	78
8	6	10	9	6	8	5	14	4	8	5	2	9	86
9	4	5	5	3	5	6	3	3	5	6	1	6	52
10	6	5	6	3	2	3	5	4	4	2	..	1	41
11	3	1	1	2	1	4	1	1	2	1	..	2	19
12	3	1	4	2	..	1	3	2	1	..	2	3	22
13	..	..	..	..	..	2	1	..	3	4	..	1	11
14	..	..	..	..	..	..	..	1	..	..	..	3	4
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	1	..	..	..	..	..	..	..	..	..	..	..	1
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	47	32	35	40	38	36	42	41	32	43	28	42	456

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	1	..	1
4	..	..	..	..	..	..	1	3	..	1	..	..	5
5	..	..	..	2	1	2	1	5	..	1	2	..	14
6	5	..	..	3	2	4	8	5	1	1	5	..	34
7	8	..	..	2	3	6	10	3	2	3	4	4	45
8	13	..	3	5	10	8	8	8	4	5	5	3	72
9	5	..	3	7	4	5	5	2	1	3	2	9	46
10	6	2	10	6	2	7	5	4	9	4	4	9	68
11	4	1	3	2	5	1	1	2	3	6	..	3	31
12	3	..	6	4	2	1	2	3	1	2	..	3	27
13	1	4	4	2	3	1	1	1	1	..	1	6	25
14	..	1	1	3	2	1	..	2	..	..	..	..	10
15	..	1	..	..	..	..	..	..	1	1	..	2	5
16	1	3	..	2	..	..	..	1	..	1	..	1	9
17	..	7	1	..	..	..	..	1	1	..	..	..	10
18	..	1	1	..	..	..	..	1	..	..	..	..	3
19	..	1	..	..	..	..	..	..	..	1	..	..	2
20	..	4	..	..	..	..	..	..	..	..	..	..	4
	46	25	32	38	34	36	42	41	24	29	24	40	411

TABLE VII
SUBTRACTION ACCURACY — COURTIS' PRACTICE TESTS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	9	10	14	7	13	2	16	5	6	11	5	8	106
90	6	3	2	..	..	1	1	6	5	3	..	..	27
80	6	14	11	7	6	11	4	6	5	9	..	8	87
70	6	6	4	2	3	6	5	7	7	6	10	2	64
60	5	5	1	4	5	4	6	2	4	4	4	6	50
50	6	..	1	4	1	3	6	..	2	2	5	2	32
0-49	2	1	1	3	3	13	4	5	4	5	15	3	59
	40	39	34	27	31	40	42	31	33	40	39	29	425

TEST II

100	5	9	4	8	13	3	18	11	7	18	13	12	121
90	5	11	1	2	4	1	4	7	11	8	4	5	63
80	9	1	7	4	2	10	5	4	6	5	5	3	61
70	5	5	5	5	1	5	6	2	3	4	1	5	47
60	3	1	4	..	2	1	2	2	2	2	2	2	23
50	4	2	7	2	2	5	3	..	2	1	2	..	30
0-49	6	2	3	5	2	7	1	..	..	1	3	5	35
	37	31	31	26	26	32	39	26	31	39	30	32	380

TABLE VIII
SUBTRACTION ACCURACY — THOMPSON'S ESSENTIALS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	15	12	4	13	7	4	9	10	6	16	4	12	112
90	5	4	..	3	1	3	2	3	..	1	..	6	28
80	12	7	3	10	2	7	11	4	9	8	2	9	84
70	6	7	8	6	7	5	5	3	8	3	4	6	68
60	3	2	7	5	8	7	6	3	5	4	4	4	58
50	1	..	5	2	4	1	5	3	1	7	1	1	31
0-49	5	..	8	1	9	9	4	15	3	4	13	4	75
	47	32	35	40	38	36	42	41	32	43	28	42	456

TEST II

100	8	9	3	8	9	3	7	16	6	11	8	10	98
90	6	5	5	9	5	..	1	4	5	6	1	7	54
80	6	4	7	11	7	6	7	5	6	4	5	12	80
70	9	4	6	5	4	10	8	3	1	3	2	6	61
60	7	1	6	2	3	1	5	3	3	2	4	2	39
50	6	2	4	2	4	5	6	5	2	2	..	3	41
0-49	4	..	1	1	2	11	8	5	1	1	4	..	38
	46	25	32	38	34	36	42	41	24	29	24	40	411

TABLE IX
MULTIPLICATION ATTEMPTS — COURTIS' PRACTICE TESTS
TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	3	..	..	..	..	..	3
1	1	..	..	..	..	2	2	..	..	..	3	..	8
2	..	..	3	1	2	4	..	..	..	1	8	2	21
3	2	..	5	3	5	5	5	2	..	..	4	3	34
4	4	2	4	5	6	10	7	3	1	..	7	4	53
5	10	5	8	5	7	8	12	5	5	2	10	7	84
6	7	17	6	7	4	7	8	3	9	5	1	8	82
7	6	7	4	2	2	4	3	4	3	10	2	6	53
8	6	5	3	1	1	1	2	4	3	11	..	..	37
9	2	2	..	3	1	..	..	1	3	2	..	..	14
10	1	..	1	..	..	..	..	2	6	5	..	1	16
11	1	..	..	..	..	..	..	3	2	2	..	..	8
12	..	1	..	..	..	..	..	1	..	1	..	..	3
13	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	1	1	..	..	2
15	..	..	..	..	..	..	..	1	..	..	..	..	1
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	40	39	34	27	28	41	42	29	33	40	35	31	419

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	1	..	..	..	..	..	1	..	2
2	..	..	..	..	1	3	1	..	..	1	3	1	10
3	..	..	..	..	..	5	3	1	..	..	6	1	18
4	1	..	1	..	..	5	4	3	3	..	8	4	51
5	4	1	5	9	5	5	4	3	3	..	8	4	68
6	10	1	13	9	2	7	9	6	2	1	3	5	43
7	5	6	4	2	2	6	10	1	..	1	1	5	51
8	4	8	3	2	5	5	5	1	3	6	3	6	55
9	7	7	4	2	3	..	2	5	7	8	2	8	33
10	3	7	1	1	1	1	1	6	4	7	..	1	19
11	1	1	..	1	1	..	2	1	3	7	..	2	13
12	2	..	..	..	..	..	..	2	5	1	3	..	11
13	..	..	..	..	..	..	2	2	3	3	..	1	2
14	..	..	..	..	..	..	..	..	..	2	..	..	4
15	..	..	..	..	2	..	..	..	..	2	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	37	31	31	26	23	32	39	28	30	39	30	34	380

TABLE X
MULTIPLICATION ATTEMPTS — THOMPSON'S ESSENTIALS

TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	1	..	..	..	..	..	..	1	..	..	6	..	8
2	2	..	..	3	..	2	1	8	..	1	8	..	25
3	2	..	1	3	9	3	3	5	1	3	6	1	37
4	5	1	13	8	6	8	3	7	1	6	5	..	63
5	12	4	14	9	7	11	2	8	6	12	..	6	91
6	15	6	4	15	7	6	16	4	9	11	1	9	103
7	4	2	3	1	7	4	5	5	7	6	1	6	51
8	5	3	1	1	1	1	5	2	2	2	..	5	28
9	..	4	..	..	..	..	1	..	3	1	1	7	17
10	..	5	..	..	1	1	1	1	..	1	..	4	14
11	..	2	..	..	..	..	4	..	1	1	..	2	10
12	..	..	..	..	..	..	1	..	..	..	..	1	2
13	..	1	..	..	..	..	..	..	1	..	..	1	3
14	1	1	..	..	..	..	..	..	..	..	..	..	2
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	47	29	36	40	38	36	42	41	31	44	28	42	454

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	..	..	..	..	..	..	..
1	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	1	..	..	2	1	..	4	..	1	..	..	9
4	2	..	..	1	3	2	..	3	1	..	3	..	16
5	5	7	..	2	7	5	9	7	3	1	5	..	51
6	8	8	1	4	6	8	14	12	4	6	2	7	80
7	10	6	2	3	1	10	1	8	7	4	8	6	66
8	6	2	7	13	8	5	9	..	5	8	3	4	70
9	6	4	4	8	2	1	3	2	4	4	2	12	52
10	4	1	6	1	2	3	3	3	2	3	..	4	31
11	3	..	4	1	..	..	1	..	..	2	..	3	14
12	1	..	2	3	..	..	1	1	..	..	..	3	11
13	..	..	2	2	1	..	1	1	..	..	1	1	9
14	..	..	1	..	..	1	..	..	1	1	..	..	4
15	..	..	1	..	..	..	..	..	..	1	..	..	2
16	..	..	1	..	..	..	..	..	..	..	..	..	1
17	1	..	..	..	..	..	..	..	..	..	..	..	1
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	46	29	31	38	32	36	42	41	27	31	24	40	417

TABLE XI
MULTIPLICATION ACCURACY — COURTIS' PRACTICE TESTS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	6	11	9	5	3	8	16	7	4	4	2	10	85
90	..	1	..	..	..	..	..	2	2	..	..	1	6
80	15	13	6	4	7	6	6	5	4	14	4	4	88
70	2	2	4	3	1	3	3	5	5	7	..	3	38
60	7	5	4	5	3	4	5	6	9	4	1	3	56
50	4	2	3	2	2	4	5	1	4	8	6	3	44
0-49	6	5	8	8	12	16	7	3	5	3	22	7	102
	40	39	34	27	28	41	42	29	33	40	35	31	419

TEST II

100	6	9	2	5	9	4	12	12	9	7	14	5	94
90	2	1	1	..	2	..	..	3	3	6	1	..	19
80	9	11	7	6	5	9	8	7	3	5	4	12	86
70	5	3	3	2	2	3	3	2	6	9	1	6	45
50	4	3	7	4	1	2	7	3	3	6	5	5	50
50	3	3	3	1	1	4	6	1	3	3	1	3	32
0-49	8	1	8	8	3	10	3	..	3	3	4	3	54
	37	31	31	26	23	32	39	28	30	39	30	34	380

TABLE XII
MULTIPLICATION ACCURACY — THOMPSON'S ESSENTIALS

TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	17	3	10	9	6	8	4	13	8	11	3	11	103
90	..	3	..	..	..	..	1	..	..	1	..	2	7
80	14	6	9	8	6	6	11	5	8	8	..	14	95
70	2	2	6	4	7	9	3	4	1	4	3	4	49
60	5	9	4	7	5	3	6	4	6	6	2	3	60
50	5	2	2	5	3	4	8	8	5	3	6	4	55
0-49	4	4	5	7	11	6	9	7	3	11	14	4	85
	47	29	36	40	38	36	42	41	31	44	28	42	454

TEST II

100	1	5	1	4	10	5	5	14	11	7	7	13	83
90	1	..	3	2	1	..	3	1	1	3	..	3	18
80	10	10	6	10	7	6	10	5	2	8	9	15	98
70	8	3	8	8	3	1	4	4	3	5	2	7	56
60	9	3	6	8	5	13	7	6	4	6	4	2	73
50	8	6	6	5	3	6	4	5	3	2	1	..	49
0-49	9	2	1	1	3	5	9	6	3	..	1	..	40
	46	29	31	38	32	36	42	41	27	31	24	40	417

TABLE XIII
DIVISION ATTEMPTS — COURTIS' PRACTICE TESTS
TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	1	..	1	2	..	..	..	..	..	4
1	1	2	3	1	4	6	6	..	..	..	6	1	30
2	5	2	4	4	6	10	4	..	1	4	3	6	49
3	11	8	10	12	9	9	7	6	6	8	8	5	99
4	6	11	8	4	5	6	12	1	8	8	7	7	83
5	3	8	4	5	4	5	7	3	5	15	4	10	73
6	5	4	3	..	..	2	2	1	4	4	2	2	29
7	6	1	..	..	1	1	1	8	4	..	..	..	22
8	..	3	..	..	..	..	..	3	2	1	..	..	9
9	3	..	1	..	..	..	..	1	1	..	1	..	7
10	..	..	1	..	..	..	..	1	1	..	..	..	3
11	..	..	..	..	..	..	..	1	..	..	..	..	1
12	..	..	..	..	..	..	1	2	2	..	1	..	6
13	..	..	..	..	..	..	..	1	..	..	..	..	1
14	..	..	..	..	..	..	..	1	..	..	..	..	1
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	40	39	34	27	29	40	42	29	34	40	32	31	417

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	1	2	..	..	..	..	..	..	3
1	..	1	..	..	..	..	..	..	..	..	..	..	1
2	..	..	1	..	..	5	1	..	..	..	2	2	11
3	5	..	5	2	5	6	6	1	..	2	3	3	38
4	6	5	7	6	4	9	6	..	5	1	9	5	63
5	7	4	5	6	3	5	13	2	3	4	5	5	62
6	2	8	9	4	3	..	6	5	2	5	2	5	51
7	4	3	3	3	2	2	2	3	2	6	1	2	33
8	8	4	..	4	3	1	2	4	2	7	4	4	43
9	1	2	..	1	..	1	..	3	2	6	..	3	19
10	2	4	..	..	..	1	..	4	3	2	2	3	21
11	..	..	1	..	..	..	1	..	1	2	2	1	8
12	1	..	..	..	..	..	1	3	2	3	..	..	10
13	..	..	..	..	..	..	..	..	2	..	..	1	3
14	..	..	..	..	..	..	1	1	1	1	..	..	4
15	..	..	..	..	1	..	..	2	3	..	..	..	6
16	..	..	..	..	..	..	..	..	1	..	..	..	1
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	36	31	31	26	22	32	39	28	29	39	30	34	377

TABLE XIV
DIVISION ATTEMPTS — THOMPSON'S ESSENTIALS
TEST I

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	..	..	..	..	..	..	2	3	..	..	..	..	5
1	2	..	..	1	..	2	1	7	..	1	5	..	19
2	6	..	..	4	1	2	5	12	2	3	1	1	37
3	9	..	3	11	19	6	4	7	4	8	10	6	87
4	9	..	8	10	10	7	9	6	3	9	8	9	88
5	9	6	8	11	4	9	11	2	10	8	3	6	87
6	5	7	7	1	2	4	2	2	3	6	1	5	45
7	3	2	2	2	1	3	6	2	2	5	..	7	35
8	..	4	5	..	..	1	1	..	3	2	..	3	19
9	2	1	1	..	..	..	..	..	1	1	..	2	8
10	1	5	1	..	..	2	..	..	1	..	..	1	11
11	..	3	..	..	..	..	..	..	..	1	..	2	6
12	..	1	..	..	..	1	1	..	..	..	..	..	3
13	..	..	..	..	..	..	..	..	..	..	..	..	..
14	1	..	..	..	..	..	..	..	..	..	..	..	1
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	47	29	35	40	37	37	42	41	29	44	28	42	451
										5.1	3.8	5.8	
										1.4	.9	1.5	

TEST II

Score Attempts	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
0	1	..	..	..	..	..	..	..	..	..	..	..	1
1	1	..	..	..	..	..	1	..	..	..	..	..	2
2	1	2	..	..	..	..	..	5	..	..	..	..	8
3	5	1	..	1	5	4	3	13	3	..	..	..	35
4	9	4	..	2	12	6	11	5	4	1	3	2	59
5	7	11	..	9	9	7	9	8	3	1	3	7	74
6	8	6	4	3	..	7	7	5	3	4	11	5	63
7	5	3	6	5	3	3	3	..	2	8	3	2	43
8	4	2	6	8	2	3	5	2	5	4	2	7	50
9	2	..	7	4	..	3	1	..	1	5	1	5	29
10	1	..	3	4	1	2	2	3	2	3	1	5	27
11	..	..	2	2	..	1	..	..	..	..	..	1	6
12	1	..	1	..	..	..	..	..	3	2	..	4	11
13	1	..	1	..	..	..	..	..	..	1	..	..	3
14	..	..	..	..	..	..	..	..	..	..	..	2	2
15	..	..	..	..	..	..	..	..	..	..	..	..	..
16	..	..	1	..	..	..	..	..	..	1	..	..	2
17	..	..	..	..	..	..	..	..	1	..	..	..	1
18	..	..	..	..	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..	1	..	..	1
20	..	..	..	..	..	..	..	..	..	..	..	..	..
	46	29	31	38	32	36	42	41	27	31	24	40	417
										8.5	6.6	8.6	
										1.4	.6	2.1	

TABLE XV
DIVISION ACCURACY — COURTIS PRACTICE TESTS
TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	10	19	9	12	7	9	13	8	9	8	4	5	113
90	..	..	..	..	..	..	..	3	1	..	..	..	4
80	3	2	3	3	1	4	5	3	1	6	..	1	32
70	4	5	4	1	3	..	5	3	4	3	3	3	38
60	7	3	4	4	2	4	5	5	7	8	2	4	55
50	5	..	2	3	3	8	4	1	6	6	4	5	47
0-49	11	10	12	4	13	15	10	6	6	9	19	13	128
	40	39	34	27	29	40	42	29	34	40	32	31	417

TEST II

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	7	16	7	11	12	6	16	17	12	17	15	9	145
90	..	1	..	..	..	..	1	1	1	2	..	1	7
80	1	3	3	5	2	4	9	7	5	11	1	13	64
70	6	2	2	2	2	4	3	2	6	2	..	1	32
60	8	4	6	1	2	1	5	..	1	3	1	..	32
50	5	2	3	4	1	4	1	1	1	1	4	3	30
0-49	9	3	10	3	3	13	4	..	3	3	9	7	67
	36	31	31	26	22	32	39	28	29	39	30	34	377

TABLE XVI
DIVISION ACCURACY — THOMPSON'S ESSENTIALS
TEST I

Score	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8	School 9	School 10	School 11	School 12	Total
100	10	8	10	12	5	10	8	12	4	14	1	6	100
90	..	3	1	..	..	1	1	..	1	1	..	1	9
80	10	7	7	4	3	7	2	..	7	4	..	7	58
70	6	..	8	4	4	4	5	2	..	5	2	6	46
60	4	9	4	11	8	6	6	3	4	8	1	5	69
50	3	1	2	5	1	5	9	10	5	3	2	7	53
0-49	14	1	3	4	16	4	11	14	8	9	22	10	116
	47	29	35	40	37	37	42	41	29	44	28	42	451

TEST II

100	10	5	6	25	9	10	10	17	10	6	12	16	136
90	2	..	4	1	1	..	1	1	1	4	..	4	19
80	7	10	10	5	5	4	10	5	6	9	7	9	87
70	4	3	5	2	1	8	4	3	1	3	..	..	34
60	6	3	2	5	3	7	2	4	2	3	1	3	41
50	4	3	2	..	8	4	3	2	1	3	..	4	34
0-49	13	5	2	..	5	3	12	9	6	3	4	4	66
	46	29	31	38	32	36	42	41	27	31	24	40	417

TABLE XVII

SUMMARY OF RESULTS BY SCHOOLS AND CLASSES

ADDITION

SUBTRACTION

SCHOOL	COURTIS MATERIAL				THOMPSON MATERIAL				COURTIS MATERIAL				THOMPSON MATERIAL			
	Speed		Accuracy		Speed		Accuracy		Speed		Accuracy		Speed		Accuracy	
	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.
School 1																
TEST I	6.8	1.6	68.8	13.4	2.5	7.6	1.2	66.0	17	6			8.7	1.7	81.6	16.4
TEST II	8.6	1.0	61.6	17.	5.2	7.6	1.5	64.0	16	6			8.8	1.8	81.1	15.
CHANGE	1.8	.6	-7.2	+3.6	2.7	0.0	+3	-2.0	1	0			.1	+1	-.5	1.4
School 2																
TEST I	8.4	1.5	80.	16.6	8	7.7	1.4	72	15	12.5			8.9	1.4	85.7	12
TEST II	9.1	1.2	80.	16.6	13	12.	2.2	70	14	14.3			10.9	1.3	94.6	10
CHANGE	.7	.3	0.0	0.0	5	4.3	+8.	-2	1	1.8			2.0	.1	8.9	10
School 3																
TEST I	7.6	1.6	87.1	18	23.5	4.7	1.2	83.7	21	0.			8.8	1.4	89.1	15
TEST II	8.6	2.0	68.	15	6.5	10.2	2.0	71.6	12	3.1			8.6	1.4	74.	15
CHANGE	1.0	.6	-19.1	3	-17.	5.5	+8	-12.1	9	3.1			-.2	0.0	-15.1	0
School 4																
TEST I	5.7	1.1	60	19	4.	8.0	1.2	81.	16.4	22			6.8	1.1	81.4	20.
TEST II	8.3	1.2	72	17	3.8	12.4	1.5	83.3	14.	10			7.8	1.2	82.5	17.5
CHANGE	2.6	+1	12	2	-.2	4.4	+3	2.3	2.4	-12			1.0	+1	1.1	2.5

TABLE XVII (Continued)

ADDITION

SUBTRACTION

SCHOOL	COURTIS MATERIAL			THOMPSON MATERIAL			COURTIS MATERIAL			THOMPSON MATERIAL		
	Speed		Accuracy	Speed		Accuracy	Speed		Accuracy	Speed		Accuracy
School 5	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.
	7.2	1.1	67.7	16	13	6.9	1.5	59.	10.	0	6.0	1.2
	9.0	2.3	87.	19	30	9.8	2.0	81.4	19.3	25	10.2	2.8
	1.8	+1.2	19.3	+3	17	2.9	+5	22.4	+9.3	25	4.2	+1.6
School 6	6.3	1.2	61	16	0	6.6	1.1	66	15.5	0	7.4	1.0
	7.6	1.7	60	18	3	9.2	1.6	66	16.5	8	8.2	1.3
	1.3	+5	-1	+2	3	2.6	+5	0	+1.0	8	.8	+3
School 7	6.5	1.1	63.3	17.3	4.8	7.2	1.1	70	20.	9.5	6.5	1.0
	8.6	2.2	86.	17.5	25.6	8.6	1.4	60	15.6	0.	9.8	1.2
	2.1	+1.1	22.7	+2	20.8	1.4	+3	-10	4.4	-9.5	3.3	+2
School 8	8.5	1.8	84.4	14	9.7	5.4	1.2	75	27.3	12	9.6	1.6
	11.1	1.8	96.6	10	39.2	7.4	1.8	83	21.	12	13.0	2.5
	2.6	0.0	12.2	4	29.5	2.0	+6	8	6.3	0	3.4	+9

School 9

TEST I	9.0	2.2	66.0	14	3	7.3	1.7	66.2	13	6
TEST II	11.6	1.5	78.	15	3	8.8	1.5	70.	14	4
CHANGE	2.6	.7	12.	+1	0	1.5	.2	3.8	+1	-2

School 10

TEST I	7.9	1.4	62.0	14	5	7.2	1.3	81	18.2	9.3
TEST II	11.3	1.3	80.	12	10	8.8	2.2	78	16.	16.
CHANGE	3.4	.1	18.	2	5	1.6	.9	-3	2.2	6.7

School 11

TEST I	6.2	1.7	61.3	15.8	3	5.5	1.4	61.8	15	7.
TEST II	8.8	1.9	83.	15.7	20	7.4	1.2	68.	20	16.6
CHANGE	2.6	+.2	21.7	.1	17	1.9	.2	6.2	+5	9.6

School 12

TEST I	8.5	1.5	72.5	25	14	8.6	1.2	66	18.5	7.
TEST II	9.0	1.7	80.	17	13	10.8	1.6	77	12.	17.5
CHANGE	.5	+.2	7.5	8	-1	2.2	+.4	11	6.5	10.5

Linwood & Thirtieth

	No Material			No Material (Linwood)			No Material (30 Dist.)		
TEST I	6.8	1.2	56.	11	7	..	..	..	..
TEST II	10.2	2.2	58.5	10	3	8.6	1.2	70	11
CHANGE	3.4	+1.0	2.5	1	-4	..	..	..	..

TABLE XVII (Continued)

MULTIPLICATION

DIVISION

THOMPSON MATERIAL

COURTIS MATERIAL

THOMPSON MATERIAL

COURTIS MATERIAL

THOMPSON MATERIAL

COURTIS MATERIAL

	Speed			Accuracy			Speed			Accuracy			Speed			Accuracy						
	Med.	M.D.	Eff.	Med.	M.D.	Eff.	Med.	M.D.	Eff.	Med.	M.D.	Eff.	Med.	M.D.	Eff.	Med.	M.D.	Eff.				
School 1																						
TEST I	6.4	1.4	80.6	17.3	2.5	6.1	1.0	85	18.6	6			4.5	1.5	65.7	18	10	4.8	1.3	75	25	4
TEST II	7.8	1.5	78.	17.	2.8	7.8	1.5	67	14.	2			6.0	1.9	65.	14	11	5.8	1.4	70	25	7
CHANGE	1.4	+1	-2.6	.3	.3	1.7	+5	-18	4.6	-4			1.5	+4	-.7	4	1	1.0	+1	-5	0	3
School 2																						
TEST I	6.8	.8	84.6	17.5	8	8.6	2.1	70	13.6	6.8			4.7	1.0	90.	14.5	15	7.0	1.8	82	18.	24.
TEST II	9.0	1.0	85.5	15.8	29	6.8	1.0	81	17.5	6.8			6.7	1.6	100.	0.	32	5.7	.9	81	17.5	6.8
CHANGE	2.2	+2	.9	1.7	21	-1.8	1.1	11	+3.9	0.			2.0	+6	10.0	14.5	17	-1.3	.9	-1	.5	-17.
School 3																						
TEST I	5.6	1.4	75.	25	5.8	5.2	.7	81.1	17.1	0.			4.0	1.1	67.5	20.	8.8	5.8	1.2	81.4	16.4	20.
TEST II	6.7	.9	67.	17	3.2	10.3	1.7	73.7	11.6	3.2			5.6	1.2	65.0	18.8	9.7	9.0	1.5	85.	11.6	19.3
CHANGE	.9	.5	-8.0	8	-2.6	5.1	+1.	-7.4	5.5	3.2			1.6	+1	-2.5	1.2	.9	3.2	+3	3.6	4.8	-7.
School 4																						
TEST I	6.0	1.5	68.	18.3	0.	5.6	1.0	72.5	17	0			3.6	.8	86.6	21	0.	4.4	1.0	70	17	2.5
TEST II	6.4	.9	70.	25.	3.8	8.6	1.1	76.2	11	5			5.8	1.2	86.0	20	15.4	7.8	1.7	100	0	50.
CHANGE	.4	.6	2.0	+6.7	3.8	3.0	+1	3.7	6	5			2.2	+4	-.6	1	15.4	3.4	+7	30	17	47.5

School 5

TEST I	5.1	1.2	60	19.	0	5.5	1.5	70	18.3	5.3
TEST II	8.2	2.1	90	11.4	16	6.7	1.6	83	18.3	9.
CHANGE	3.1	+ .9	30	7.6	16	1.2	+ .5	13	0.	3.7

School 6

TEST I	5.0	1.2	62.5	19.5	2.4	5.4	1.0	76	15	0
TEST II	6.4	1.3	70.	20.	6.	7.2	1.1	65	12	8
CHANGE	1.4	+ .1	7.5	+ .5	3.6	1.8	+ .1	- 11	3	8

School 7

TEST I	5.3	1.0	81.6	21	4.8	6.7	1.2	66.7	17	7.1
TEST II	7.3	1.2	81.2	20	15.4	6.8	1.2	72.5	15	9.5
CHANGE	2.0	+ .2	- .4	1	11.	+ .1	0.	5.8	2	2.4

School 8

TEST I	7.5	2.1	80.	17.3	7	5.0	1.7	78	25	5
TEST II	9.4	2.5	93.3	10.	32	6.6	1.1	80	20	7
CHANGE	1.9	+ .4	13.3	7.3	25	1.6	.6	2	5	2

School 9

TEST I	7.6	1.7	68.0	11.6	9	6.9	1.0	81.2	20	10
TEST II	10.0	1.6	80.	17.5	26	7.8	1.3	85.	20	22
CHANGE	2.4	.1	12.	+ 5.9	17	.9	+ .3	3.8	0	12

TABLE XVII (Continued)

MULTIPLICATION

DIVISION

COURTIS MATERIAL				THOMPSON MATERIAL				COURTIS MATERIAL				THOMPSON MATERIAL			
		Speed		Accuracy		Speed		Accuracy		Speed		Accuracy		Speed	
		Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.	Med.	M.D.
School 10															
TEST I	8.3	1.2	77	12	7.5	6.0	1.1	75.	25	0		5.0	.9	66	17.
TEST II	10.4	1.4	79	15	18.	8.5	1.5	83.7	15	19		8.3	1.6	90	11.4
CHANGE	2.1	+2	2	+3	10.5	2.5	.4	8.7	10	19		3.3	+7	24	5.6
School 11															
TEST I	4.4	1.3	41	0.	0.	3.0	1.1	50	10	0		3.9	1.5	42.1	0.
TEST II	5.6	1.2	90	12.7	13.3	7.3	1.3	84	16	20		5.2	1.4	90.	.6
CHANGE	1.2	.1	49	+12.7	13.3	4.3	+2	34	+6	20		1.4	.1	47.9	+14.
School 12															
TEST I	6.0	1.1	80	21	6.	7.8	1.5	84.8	15.7	12		4.6	1.1	56	11
TEST II	8.2	1.3	80	13	8.8	9.3	1.5	87.3	10.	25		6.4	2.0	83	17
CHANGE	2.2	+2	0	8	2.8	1.5	0.	3.0	5.7	13		1.8	+9	27	+6
Linwood and Thirtieth															
No Material															
TEST I	6.4	.9	63.	18.7	2.3	..	..	..	..	..		4.8	1.6	64	16.4
TEST II	7.1	1.7	57.5	11.	3.	6.9	1.0	77.5	13	8		6.5	1.5	60	19.
CHANGE	.7	+8	-5.5	7.7	.7	..	..	..	..	..		1.7	.1	-4	+2.6
No Material															
TEST I															
TEST II															
CHANGE															

TABLE XVIII
A COMPARISON OF CLASSES FOR MEDIAN RESULTS IN ADDITION ACCURACY

School	1	2	3	4	5	6	7	8	9	10	11	12	Total	Aver- age
Courtis														
TEST I	68.8	80	87.1	60	67.7	61	63.3	84.4	66	62	61.2	72.5		
TEST II	61.6	80	68.	72	87.	60	86.	96.6	78	80	83.	80.		
GAIN	-7.2	0	-19.1	12	19.3	-1	22.7	12.2	12	18	21.8	7.5	98.2	8.2
Thompson														
TEST I	66	72	83.7	81.	59.	66	70	75	66.2	81	61	66		
TEST II	64	70	71.6	83.3	81.4	66	60	83	70.	78	68	77		
GAIN	-2	-2	-12.1	2.3	22.4	0	-10	8	3.8	-3	7	11.	25.4	2.1

Using the median growth as a measure of comparison, eight classes using the Courtis material increased their per cent of accuracy in addition, three decreased, and one made no change, as compared with six, five, and one, respectively, using the Thompson material. The sum total and average (of the median gains) show in the last columns above (Table XVIII). With classes compared, these are approximately the results also in subtraction and multiplication. In division, the number of classes making median gains or losses was equal. The following table, XIX, shows these data, together with the gross algebraic gain in efficiency. (The per cent of pupils attempting or exceeding a certain number of examples with one hundred per cent accuracy.)

TABLE XIX

	Courtis Material Classes				Thompson Material Classes			
	Gained	No Change	Lost	Gross Efficiency gain	Gained	No Change	Lost	Gross Efficiency gain
Addition	8	1	3	81.8	6	1	5	41.2
Subtraction	10		2	151.1	9		3	31.4
Multiplication . .	8	1	3	121.7	9		3	84.3
Division	9		3	212.8	9		3	144.4

Number of classes, however, making gains or losses is a poor measure of comparison, because the amounts of gain or loss have no weight. A more just and exact method would be a grouping of all pupils in either of the two materials. Inequalities and variations would tend to be "smoothed out" in the larger massing, and medians

would more nearly approximate the true conditions. The following frequency tables (XX to XXII) show the total number making a score in attempts or in per cent accuracy regardless of class, and herein lie the most valid comparisons. Charts I to V picture these results:

TABLE XX
COURTIS' PRACTICE PADS
ATTEMPTS — 12 CLASSES
FREQUENCY TABLES — TESTS I AND II

Score	Addition		Subtraction		Multiplication		Division	
	I	II	I	II	I	II	I	II
0	..	..	1	..	3	..	4	3
1	..	..	1	..	8	..	30	1
2	9	..	7	1	21	2	49	11
3	11	4	7	1	34	10	99	38
4	37	5	26	5	53	18	83	63
5	67	24	59	12	84	51	73	62
6	69	34	64	43	82	68	29	51
7	76	48	63	36	53	43	22	33
8	62	65	77	56	37	51	9	43
9	39	48	40	50	14	55	7	19
10	18	47	38	50	16	33	3	21
11	14	36	20	32	8	19	1	8
12	11	27	13	29	3	13	6	10
13	2	16	4	25	..	11	1	3
14	3	10	1	18	2	2	1	4
15	2	8	1	6	1	4	..	6
16	2	6	3	5	..	..	..	1
17	2	2	..	2	..	..	..	..
18	..	1	..	3	..	..	..	..
19	..	1	..	3	..	..	..	..
20	..	1	..	3	..	..	..	..
	424	383	425	380	419	380	417	377
Med.	7.2	9.3	7.8	9.7	6.1	7.9	4.3	6.2
M.D.	1.5	1.9	1.6	2.0	1.4	1.8	1.2	1.9
Gain	..	2.1	..	1.9	..	1.8	..	1.9

TABLE XXI
 THOMPSON'S ESSENTIALS
 ATTEMPTS — 12 CLASSES
 FREQUENCY TABLES — TESTS I AND II

Score	Addition		Subtraction		Multiplication		Division	
	I	II	I	II	I	II	I	II
0	1	..	..	..	..	..	5	1
1	3	..	3	..	8	..	19	2
2	11	1	6	..	25	..	37	8
3	19	4	7	1	37	9	87	35
4	63	14	27	5	63	16	88	59
5	49	25	40	14	91	51	87	74
6	83	37	59	34	103	80	45	63
7	76	44	78	45	51	66	35	43
8	68	77	86	72	28	70	19	50
9	38	46	52	46	17	52	8	29
10	20	34	41	68	14	31	11	27
11	8	34	19	31	10	14	6	6
12	9	32	22	27	2	11	3	11
13	1	21	11	25	3	9	..	3
14	5	17	4	10	2	4	1	2
15	..	13	..	5	..	2	..	..
16	..	9	1	9	..	1	..	2
17	2	5	..	10	..	1	..	1
18	..	1	..	3	..	..	..	..
19	..	1	..	2	..	..	..	1
20	..	2	..	4	..	..	..	..
	456	417	456	411	454	417	451	417
Med.	7.0	9.2	8.1	9.7	6.0	7.8	4.9	6.5
M.D.	1.5	2.1	1.6	1.7	1.4	1.5	1.3	1.8
Gain	..	2.2	..	1.6	..	1.8	..	1.6

TABLE XXII
COURTIS' PRACTICE PADS
ACCURACY — 12 CLASSES
FREQUENCY TABLES — TESTS I AND II

Score	Addition		Subtraction		Multiplication		Division	
	I	II	I	II	I	II	I	II
100	66	68	106	121	85	94	113	145
90	12	29	27	63	6	19	4	7
80	71	86	87	61	88	86	32	64
70	56	56	64	47	38	45	38	32
60	68	50	50	23	56	50	55	32
50	58	38	32	30	44	32	47	30
0-49	93	56	59	35	102	54	128	67
	424	383	425	380	419	380	417	377
Med.	68.9	78.6	80.9	89.0	72.1	81.0	66.2	84.4
M.D.	16.8	15.0	17.2	16.3	20.6	17.8	19.3	19.8
Gain		9.7	..	8.1	..	8.9	..	18.2

THOMPSON'S ESSENTIALS
ACCURACY — 12 CLASSES
FREQUENCY TABLES — TESTS I AND II

Score	Addition		Subtraction		Multiplication		Division	
	I	II	I	II	I	II	I	II
100	78	73	112	98	103	83	100	136
90	12	28	28	54	7	18	9	19
80	67	68	84	80	95	98	58	87
70	70	51	68	61	49	56	46	34
60	62	74	58	39	60	73	69	41
50	69	62	31	41	55	49	53	34
0-49	98	61	75	38	85	40	116	66
	456	417	456	411	454	417	451	417
Med.	69.8	72.3	79.4	83.4	75.5	78.4	68.2	83.9
M.D.	16.6	16.8	18.0	15.8	18.7	14.0	18.3	18.9
Gain	..	2.5	..	4.0	..	2.9	..	15.7

TABLE XXIII

MEDIAN SCORES — SERIES B — ATTEMPTS AND RIGHTS

380 classes — 5th Grade

353 classes — 6th Grade

COURTIS' SUPERVISORY GRAPH — 1913-14 TABULATIONS

	Addition		Subtraction		Multiplication		Division	
	Atts.	Rts.	Atts.	Rts.	Atts.	Rts.	Atts.	Rts.
Grade 5	7.6	4.5	8.1	5.9	6.4	4.0	4.9	3.0
Grade 6	8.9	5.7	9.5	6.8	7.8	5.3	6.8	5.9
400 5th Graders after 15 minutes' practice daily, February to June (Courtis Pads)	9.3	7.3	9.7	8.6	7.9	6.4	6.2	5.2

TABLE XXIV

MEDIAN ACCOMPLISHMENTS OF 881 FIFTH-GRADE CINCINNATI PUPILS
ON FEBRUARY 1, 1916, COMPARED WITH MEDIAN ACCOMPLISH-
MENTS OF FIFTH- AND SIXTH-GRADE PUPILS IN GENERAL

	Addition		Subtraction		Multiplication		Division	
	Atts.	Rts.	Atts.	Rts.	Atts.	Rts.	Atts.	Rts.
Standard (Median) June Scores								
5th Grade	7.6	4.5	8.1	5.9	6.4	4.0	4.9	3.0
6th Grade	8.9	5.7	9.5	6.8	7.8	5.3	6.8	5.9
7th Grade	9.8	6.4	10.4	7.9	8.9	6.2	8.4	6.7
Initial Ability Courtis Group (425)	7.2	4.96	7.8	6.3	6.1	4.4	4.3	2.8
Initial Ability Thompson Group (456)	7.0	4.88	8.1	6.4	6.0	4.5	4.9	3.34
Final Ability Courtis Group (383)	9.3	7.3	9.7	8.6	7.9	6.4	6.2	5.2
Final Ability Thompson Group (417)	9.2	6.65	9.7	8.1	7.8	6.1	6.5	5.45

EXTRACTS FROM TEACHERS' GENERAL OPINIONS AND
CRITICISMS

Courtis Material

Etta O'Hara, Madisonville School:

It seems to me that there was too much time consumed for the results obtained. Where there was improvement it was in the speed at the expense of accuracy.

The tests themselves were good but would have been more effective earlier in the year. The first test is a little long.

Stella M. Hummel, Bloom School:

I think that oral drill should be added to the written tests, alternating with written tests.

The class made a gain in speed at the expense of accuracy.

Anna D. Pugh, Bloom School:

In order that the pupil receive the most good from these tests, he should be drilled *each time* on the mistakes he has made. This would take more time than our crowded programs would permit. If the tests were given say twice a week, and the period the remaining three days be given to individual drill, there would be more profit. Even this much time, however, could not be given unless the arithmetic course be shortened.

When papers were returned to pupils for practice, I found them trying to remember the answers, instead of practicing the work. This was not true in all cases, of course. Would it be possible to vary the position of the problems on different sheets?

Katherine Nunn, Highlands School:

I feel greatly pleased with the interest of the class. The children always begged to have the work twice a day and they carefully watched and compared their own improvement, and were disappointed if they fell behind their own record of the day before. I shall use it next year even if it is only the daily practice work that is available. I consider it invaluable and would like to know about the reading test also.

Elizabeth Braunecker, Garfield School:

This kind of work is very valuable. The attitude toward their work which was engendered in the children is certainly a

very commendable feature. Although the improvement was not as great as I had expected, I still regard the experiment as successful.

Georgeina Brandstettner, West Oakley School:

I think the practice is splendid, but I think it is better for all pupils to work on the same lesson.

Principal H. L. Crane:

Practice with the Courtis material has given much better results, in our school, than that with the Thompson material.

Laura Knight, Stowe School:

Although much time has been taken up by these tests, yet it has developed accuracy and speed that would not have been gained otherwise. Pupils who used to resort to the book for tables never think of doing so now.

Principal Jennie D. Porter:

My opinion is that the Courtis Standard Practice Tests are of practical value to the child and teacher, showing the child's deficiency in fundamentals. Used as a test twice a year, it will be very valuable, as it spurs the child to strive for exactness and develops accuracy and efficiency.

Aline Morgan, Westwood School:

If a different plan for having answers marked could be found, it would prevent copying. The class profited and interest was sustained throughout.

Principal J. O. Beck:

It is the opinion of both the teachers and myself that the Courtis method is the best. It is easier to control and advance individual progress by the Courtis. But we find that pupils see the answers in spite of the watchfulness of the teacher and it is impossible to erase the figures entirely from Series B.

Mollie Brisbin, Sixth District School:

The work is very beneficial to the child, but a great deal of time is taken from the arithmetic period.

H. Elizabeth Brown, Douglass School:

The class profited very much. Interest was sustained throughout.

Principal F. M. Russell:

Courtis ahead for accuracy.

Thompson required less of teacher's time.

Great improvement noticed in pupils in both cases.

Margery Houser, Avondale School:

I consider the "tests" altogether worth while, and hope to have the material for my next class. The tests proved a stimulus to the weaker pupils. The last day was just as interesting as the first. The pupil seeing his own progress was a great help.

Principal L. P. Stewart (acting):

We considered this class as scarcely up to the standard of our fifth grades. Yet these tests have enabled this class to produce results that compare very favorably with the other fifth grade, especially in accuracy. I am inclined to favor this written work over the Thompson's.

Jessie G. Fischer, Sherman School:

The material was excellent for quick, thorough drills in the fundamentals. Without such material we are prone to grow lax in giving daily drills for speed and accuracy which are so necessary later on. The interest alone would make it invaluable and assures profit.

Thompson Material

Mabel Rybolt, Madisonville School:

1. First three processes would be more effective in the fourth grade.

2. Not varied enough.

3. Too much work in detail for the teacher for the amount of good the class received.

4. Effect upon daily improvement — almost none.

5. Speed improved slightly at expense of accuracy. Interest was not sustained.

Clara Roth, Raschig School:

I think there are other methods, just as good, that do not take so much time. These tests require much time on the part of the teacher in looking over the work and recording results.

Principal William Kaefer:

No opinion can be formed, as only one kind of material was used.

K. H. Riley, Bloom School:

The children have improved both in speed and accuracy. This has been shown in the regular grade work. The only criticism was the amount of time consumed, not in the rapid oral drill, but in the written tests.

D. E. Kruckemeyer, Fairview School:

I should like to see the *Essentials* or some similar system introduced into *all* grades because children's failures in arithmetic are most often attributed to the fact that they have not mastered the four fundamental processes. In the beginning accuracy should always be the chief aim, to be followed by speed. The mastery of these processes will enable pupils to give their undivided attention to mastering new processes introduced by the new work of the grade, — giving them the opportunity to concentrate.

Mary Sullivan, Evanston School:

The drill work was very helpful. The addition and subtraction might be profitably used in the third grade, the multiplication and division in the fourth grade, the four processes in the fifth grade. The children liked the work.

Principal U. D. Clephane:

We feel that the work in Thompson's *Minimum Essentials* has been very successful. The drill work was especially helpful. We believe that our pupils have been benefited and I should like to see the work continued.

Amy See, Garfield School:

Several of the tests have 150 or 120 examples to be marked on the scale of 100. This requires too much time on the part of the teacher. Found that the bright pupils often did not do as well as the duller ones. The class did not profit a great deal.

Edith S. Fridman, West Oakley School:

I believe each teacher, knowing the needs of her class, could provide drill work that would not take as much time and be just as effective. If the children would get their combinations and tables more thoroughly in lower grades, very little of this kind of drill would be necessary in the fifth grade.

Principal H. L. Crane:

Practice with the Courtis material undoubtedly gives best results.

Anna Sanford, Stowe School:

One side of the sheet instead of two would be sufficient for oral work. The drill is excellent, as the pupils realized their deficiency and the competition encouraged them to improve in accuracy and speed in the fundamentals.

Principal Jennie D. Porter:

My opinion is that Thompson's *Minimum Essentials* are better suited to Primary Grades.

May Warnking, Westwood School:

Have only 100 problems on each sheet, so the percentage is easier to obtain (especially white test sheets). I prefer the Courtis material.

Alma Getz, Sixth District School:

The class as a whole has been benefited by the Thompson *Minimum Essentials*. The work has made them speedier and more accurate, as the tests show. The oral work connected with the Thompson Tests has been a very helpful feature.

Principal J. S. Hauer:

Both are good. Each teacher liked best the test her class used.

The Thompson *Minimum Essentials* take much less time than Courtis', but the latter arouse and hold the interest of children more.

H. A. Parham, Douglass School:

Horizontal operations in four fundamentals do not seem to deserve the same importance as vertical operations.

Two digit subtractions and division by numbers of two

digits could be eliminated possibly without loss. The class profited.

Edna M. Spillard, Avondale School:

I enjoyed the work and hope to use it every year with all classes.

The children found the motive for progress a stimulus. The idea of speed seemed to take such a strong hold upon them, that I sometimes feared that that point was overemphasized by the children.

Principal L. P. Stewart (acting):

The results show great value in both kinds of practice. I am inclined to favor the written as more effectual than the oral work.

THE VALUE OF PRACTICE WORK

The author was curious to know whether or not the practice effect from February to June carried over into the following year when the classes were pursuing their "regular" work. The best results, no doubt, would come from classes pursuing brief practice periods over several school years. It would not be surprising that, after systematic practice was discontinued, pupils should fall back into former habits of work. No actual tests were made to ascertain the effect of the previous year's practice, except in two cases noted below, but the various sixth-grade teachers were asked to give their "opinions." These opinions are given only for what the reader may consider them worth. No effort was made to distinguish between the groups using the respective materials. A letter of the form below was sent to each Principal:

February 2, 1917

Mr. J. O. BECK,
Principal Westwood School,
Cincinnati, Ohio.

My dear Mr. Beck:

Practice material in the fundamentals was used several minutes daily last year for four months in two of your fifth grades. Will you please ask the present sixth-grade teachers of these promoted groups whether or not they notice "any difference" in the work of such pupils this year in the fundamentals? Have them state their opinions briefly on this same page and return.

Thanking you, I am

Very truly yours,

Fifteen sixth-grade teachers replied. Some of the fifteen have the combined fifths of last year, so that about twenty classes of the original twenty-four are represented. Of the fifteen teachers replying, ten notice the previous year's improvement in the fundamentals carrying over into their present sixth grades; one notices improvement in two fields; two notice no improvement; and two say they are not able to tell. Actual tests were conducted with two groups representing three classes of the previous year. In these tests, the pupils with practice showed to advantage. Three replies typical of the above are given:

"The entire class had the practice work. The comparison between the sixth grade of last year and the present one shows that the pupils who had the practice work are more efficient."

"I cannot see that it has made any difference at all. Nearly all the trouble in the arithmetic work is due to carelessness."

"In my semi-annual office tests in arithmetic, I have found sufficient data to make me believe that there has

been a decided gain on the part of the class using the practice material."

It is not strange that after several months of discontinuance some pupils should lose some of the proficiency previously acquired. Practice, by the very nature of things, means repetition until the habit has been fixed, and even then it must be followed frequently if one retains his previous skill. Correct number habits are skills to be acquired. The nervous system gradually relegates them to the "automatic," until little thinking is needed in their exercise. But number skills acquired are attained best under short but frequent units of practice, during which time pupils are working to their limit with the added zest of effort toward surpassing their previous records.

Controlled experiments with large groups of children indicate that three- to five-minute periods produce the best results. (See Kirby, *Practice in the Case of School Children*, Teachers College, Columbia; and Brown, *The Value of Drill*, February, 1911, *Journal of Educational Psychology*.) The best practice material devised for perfecting pupils in the fundamentals recognizes these principles which have been deduced from scientific experiment. Such material should provide for short but frequent periods, during which the individual pupil is competing with himself on the difficulty that he himself has encountered. He progresses just as rapidly as his individual difficulties permit him. Such practice should be pursued over a series of years. It should occupy only the smaller part of the recitation time. Its chief justification lies in the fact that automatic number habits should function in the concrete, practical, thinking situations of the real arithmetic.

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Educat.
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Author Mead, Cyrus DeWitt

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